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NASA TECH BRIEF

Method for Predicting Pump Cavitation Performance

A method (based on mathematical models) which predicts the cavitation performance for pumps and inducers has been developed. This method requires that two sets of appropriate test data be available for each pump to be analyzed. These test data need not necessarily be for the same liquid, liquid temperature, or rotative speed; however, at least one set of data must provide measurable thermodynamic effects of cavitation. Another prerequisite is geometric similarity of pump blade and cavitated regions. From these reference tests, accurate predictions of cavitation performance for a given pump can be made for other liquids, liquid temperatures, and/or rotative speeds.

Various analyses which related thermodynamic effects of cavitation to pump performance are available. Although they are useful in predicting trends, their applicability is somewhat limited because either (1) the analysis does not predict quantitative values or (2) the experimental data used does not adequately cover the range of fluid properties and flow conditions of current interest. Also, existing analyses do not account for the effects of heat transfer, flow velocity (and its relation to heat transfer), or size of pump (scale).

The accurate prediction of thermodynamic effects of cavitation is considered necessary for an optimum flow system which is designed to operate with cavitation.

As a result of this requirement, pump prediction equations are developed taking into consideration the following elements: (1) properties of the pumped liquid and its vapor, (2) heat transfer, (3) flow velocity, (4) pump scale, and (5) NPSH (Net Positive Suction Head).

This prediction method is applied to an axial flow inducer and to several centrifugal pump impellers. These rotors are operated in several different liquids at various temperatures. Experimental and predicted cavitation performance results are compared for: (1) an inducer operated in liquid hydrogen at various temperatures, (2) two centrifugal pump impellers operated at various values of flow coefficient and rotative speed in constant-temperature hydrogen, and (3) several small commercial centrifugal pumps operated in a variety of liquids (water, methyl alcohol, butane and Freon-11). This method of predicting the cavitation performance results in consistently good agreement between predicted and experimental results.

Notes:

1. Use of the prediction method may provide substantial reductions in the cost and development time required for new pump designs. It is also applicable to analyzing performance of existing pumps in new and varying operating conditions.
2. Documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10446
3. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B69-10446

Patent status:

No patent action is contemplated by NASA.

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Category 02